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EXAMINER	
SETH, MANAV	

ART UNIT	PAPER NUMBER
2625	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/756,172	THIERET ET AL.	
	Examiner	Art Unit	
	Manav Seth	2625	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 June 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *12-24* is/are allowed.

6)☒ Claim(s) *1-11* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06/10/2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *05/20/2004*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. The disclosure is objected to because of the following informalities:

While there is no set statutory for claims, the present US Patent Office practice is to insist that each claim must be the object of a sentence starting with "I (or we) claim," "The invention claimed is" (or the equivalent). (**See MPEP, 608.01 (m) [R-2] Form of Claims**)

Appropriate correction is required.

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description:

Figure 2 does not show element 22 as specified in the specification on page 8, line 28.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by

the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

3. **Figure 3** should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

4. The disclosure is objected to because of the following informalities:

Specification on line 3 of page 9 shadows emission shadow labeled as "39" whereas figure 2 shows emission shadow labeled as "38". Specification is not consistent with the figure 2.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1, 2 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Webber et al., U.S. Patent No. 6,289,235.

Claim 1 recites "In reconstruction imaging in which a volume is reconstructed from a series of measured projection images, each generated by projection of a radiation source positioned at a respective focus through the volume to a detector at which the respective measured projection image is acquired ("detector plane"), an improved method of back-projecting a two-dimensional (2D) representation (first 2D representation") to a generate three-dimensional (3D) representation, where the first 2D representation is in the detector plane, the improvement comprising for each of one or more slices of the 3D representation parallel to the detector plane and for each distinct focus at which a said measured projection images is generated, performing the steps of". Webber discloses a method and system for creating three-dimensional images using tomosynthetic computer tomography (Title). Webber further discloses the use of a detector to record a series of projected images, where each image (2D image) generated by projection of a radiation source is positioned at a respective focus through the object (volume), element 21, to a detector at which the

respective measured projection image (2D image) is acquired (figure 1, col. 2, lines 15-27, lines 50-67). Webber further teaches selected slice position 35 is parallel to the detector plane 31 (figure 1, col. 5, lines 25-42). Webber further discloses the system being used to synthesize a three dimensional reconstruction (back-projection) of the object (volume) from a plurality of projected images (2D images) detected at the recording medium (detector) (figure 2, col. 3, lines 1-5).

Claim 1 further recites "warping the first 2D representation to generate a second 2D representation, the warping step including applying to the first 2D representation a selected linear mapping, where that selected linear mapping would map, in order to match dimensions of the respective slice within the 3D representation, a region defined by projection, at the respective focus, of corners of that slice onto the detector plane". Webber further discloses warping, i.e. transforming or mapping, a series of projected (first 2D) images onto the virtual projection plane to yield modified (second 2D) images that would match (linearly mapped) those that have been generated on the detector plane where detector plane been in a fixed position relative to the object (3D volume) (col. 3, lines 5-13). It is obvious from the above disclosure by Webber that warping or mapping of images if done to match or generate a similarity between images has to be done point by point or pixel by pixel mapping which is basically a linear mapping and apparently mapping cannot be done by not considering the corners of the image to be warped.

Claim 1 further recites "incrementing values of each of one or more voxels of the respective slice by an amount that is a function of a value of a correspondingly indexed pixel of the second 2D representation". Webber further discloses "magnification differences can be compensated for by appropriate scaling of the images" (col. 3, lines 15-16). It is clear from the above disclosure by Webber that after mapping when warping results in increase of size (magnification) of image, to keep up to the resolution of the image, the pixel values is needed to be increased or incremented which is basically scaling of the image.

Claim 2 recites "In the reconstruction imaging of claim 1, the further improvement comprising forward-projecting the three-dimensional (3D) representation ("first 3D representation") to generate a two-dimensional (2D) hypothetical projection image". As discussed in the rejection of claim 1, Webber further discloses warping, i.e. transforming or mapping, a series of **projected (first 2D or the respective slice of the first 3D representation) images** onto the **virtual (hypothetical) projection plane** to yield **modified (second 2D or respective slice of the second 3D representation) images (hypothetical images)** that would match (linearly mapped) those that have been generated on the detector plane where detector plane been in a fixed position relative to the object (3D volume or representation)) (col. 3, lines 5-13) which is basically forward-projection of the three-dimensional representation to generate a two-

dimensional hypothetical image. All other limitations of claim 2 have been similarly analyzed and rejected as per claim 1.

Claim 7 has been similarly analyzed and rejected as per claims 2 and 1.

7. Claims 3 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Webber et al., U.S. Patent No. 6,289,235, further in view of Selldin, February 20, 2002, "Design and implementation of an application programming interface for volume rendering".

Claim 3 recites "In the reconstruction imaging of claim 1, the further improvement comprising executing at least the warping step on a graphics processing unit (GPU) coprocessor". Webber as discussed in the rejection of claim1 discloses a method and system for creating three-dimensional images using tomosynthetic computed tomography. Webber does not specifically teach a graphics processing unit (GPU). It is clear from this disclosure by Webber that a computer is required for processing the images to generate 3D representation by combining 2D representations and this operation apparently has to be done by the processor that is capable of image or graphics processing and such a processor is an inherent requirement in the system and use of graphics processing unit is very well known in the art of image or graphics processing and is further supported by Selldin. Selldin in his/her thesis teaches an application programming interface (API) which can be used efficiently to examine volumetric data sets from CT or MRI scans (abstract, page iii). Selldin further discloses that

standard PC graphics cards such as GeForce3 can further be used for volume rendering (page 20, lines 1-10). A computer has to have a PC card or a graphics producing circuit to render a 3D object on display.

Therefore, it would have been obvious for one of ordinary skill in the art at the time of invention to use a graphics processing unit as disclosed by Selldin in Webber's invention. One would have been motivated to use a graphics processing unit as disclosed by Selldin in Webber's invention because both references belong to the same application of medical field and Selldin provides the teaching that a standard PC graphics card or circuit can be used in 3D image representation. A graphics or image processing unit is the inherent requirement in the computer system and no image or graphics can be displayed on the computer display without having graphics or image processing unit.

Claim 8 has been similarly analyzed and rejected as per claim 3 and 7.

8. Claims 4 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Webber et al., U.S. Patent No. 6,289,235, further in view of Selldin, February 20, 2002, "Design and implementation of an application programming interface for volume rendering" and further in view of Jain, June 18, 2001, "A programmable graphics chip".

Claim 4 recites "In the reconstruction imaging of claim 3, the further improvement wherein the GPU is of the type having a programmable pixel shader and a programmable vertex shader". Webber does not teach specifically

of the structure of GPU. However, Selldin teaches that nVidia Geforce3 graphics-processing unit (GPU) can perform advanced shading and vertex manipulation (page 20, para. 2, lines 1-3). NVidia Geforce3 is a programmable chip and it's structure has a vertex shader and pixel shader integrated in it and this is further disclosed by Jain. Jain on page 2 of 5 discloses that Geforce3 structure consists of a vertex shader and a pixel shader.

Therefore, it would have been obvious for one of ordinary skill in the art at the of the invention was made to use Jain's teaching of including vertex and pixel shader in GPU in the combined invention of Selldin and Webber. One would have been motivated to use Jain's teaching of including vertex and pixel shader in GPU in the combined invention of Webber and Selldin because Jain provides the internal architecture of the graphics unit processor used in the combined invention of Webber and Selldin and Jain further provides the teachings on the advantages of using vertex and pixel shader in the GPU. Jain teaches that vertex shader gives the programmer the ability to alter the vertex information which is basically performing warping and pixel shader will accept the data from the vertex shader and would combine the color and lightning information and will perform advanced features like shadow mapping (page 3 of 5).

Claim 9 has been similarly analyzed and rejected as per claim 4, 8 and 7.

9. Claims 5, 6, 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Webber et al., U.S. Patent No. 6,289,235, further in view of

Selldin, February 20, 2002, "Design and implementation of an application programming interface for volume rendering" and further in view of Jain, June 18, 2001, "A programmable graphics chip" and further in view of McCool, 1st August 2000, "SMASH: A next generation API for programmable graphics accelerators".

Claim 5 recites "In the reconstruction imaging of claim 3, wherein the GPU has one or more instructions that provide for parallel processing of multi-component operands, the further improvement comprising executing such an instruction with a lower-order portion of a mantissa in one component of an operand and a higher-order portion of that mantissa in another component of that same operand". As discussed in the rejection of claim 3 and 4, Webber and Selldin do not teach the internal structure of the GPU but Jain provides the internal structures of the programmable graphics chip nVidia GeForce3 which can be used for 3D representations. Jain further teaches on page 4 of 5 that four 32-bit memory controllers are interleaved which will help in preserving bandwidth. It is apparent from Jain's disclosure that using multiple processors will not only preserve bandwidth but will also provide faster processing executing in parallel. Jain does not teach the internal structure and operation at the operand level. However, McCool teaches an application programming interface (API) to be used for GPUs and provides the teachings of the internal structure where a simplified multithreaded architecture could potentially run at full CPU utilization and each thread would run slower so we would have to have many shader processors running in parallel (page 21, left column, last para.). McCool teaches the arithmetic operations performed in the GPU where left (high-order) and right

(low-order) operands are used to perform arithmetic operations such as sum (add), product, etc (page 12, right column through page 13, left column). McCool further teaches of processing a specific number of bits in Mantissa (page 15, right column, para. 6).

Therefore it would have been obvious for one of ordinary skill in the art to use the teachings of McCool of using parallel processing of multi-component operand in the combined invention of Webber, Selldin and Jain. One would have been motivated to use the teachings of McCool of using parallel processing of multi-component operand in the combined invention of Webber, Selldin and Jain because all the references are directed to image processing and McCool further provides the teachings of the internal structure where a simplified multithreaded architecture could potentially run at full CPU utilization and each thread would run slower so we would have to have many shader processors running in parallel to get good performance (page 21, left column, last para.).

Claim 6 recites "In the reconstruction imaging of claim 5, the further improvement wherein the instruction is an add instruction". As discussed in claim 5, McCool performs different arithmetic operations such as add, etc. Claim 6 has been similarly analyzed and rejected as per claim 5.

Claim 10 has been similarly analyzed and rejected as per claims 5, and 9.

Claim 11 has been similarly analyzed and rejected as per claims 6, and 10.

Allowable Subject Matter

10. Claims 12-24 are allowed.

The following is an examiner's statement of reasons of allowance:

Both the instant invention and the closest prior art Webber et al., U.S. Patent No. 6,289,235 are directed to a method of rendering a three dimensional representation of a object volume using projected two dimensional images. The instant invention further recites the limitation "the back-projecting step including warping the second 2D representation to generate a third 2D representation by mapping pixels of the second 2D representation to pixels of the third 2D representation as if rays from the source, when positioned at the respective focus, projected through the volume at a substantially constant angle normal to the detector plane of the respective projection, where the second and third 2D representations are in the detector plane." in claim 12 whereas Webber does not teach the back-projecting step including warping the second 2D representation to generate a third 2D representation by mapping pixels of the second 2D representation to pixels of the third 2D representation using the ray projections at a constant angle. Therefore claim 12 is allowed. Claims 13-24 are dependent on claim 12 and therefore are allowed.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- Moshfeghi, U.S. Patent No. 5,633,951, discloses a method for registration of volumetric images, which are relatively elastically deformed by matching surfaces.
- Kaufman et al., U.S. Patent Publication No. 2004/0125103A1, discloses a method and apparatus for volume processing and rendering.
- Georgiev, U.S. Patent No. 6,268,846, discloses a method of 3D graphics based on images and morphing.
- Tanaka, U.S. Patent No. 5,412,764, discloses 3D image display apparatus using numerical projection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Manav Seth whose telephone number is (571) 272-7456. The examiner can normally be reached on Monday to Friday from 8:30 am to 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's trainer, Joseph Mancuso, can be reached on (571) 272-7695. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Manav Seth
Art Unit 2625
March 25, 2005

JOSEPH MANCUS
PRIMARY EXAMIN